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(54) **SYSTEM AND METHOD FOR COORDINATING FIELD USER TESTING RESULTS FOR A MOBILE APPLICATION ACROSS VARIOUS MOBILE DEVICES**

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G06F 11/22	(2006.01)

(52) **U.S. Cl.**

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(58) **Field of Classification Search**

USPC 714/38.1

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,044,398	A	3/2000	Marullo et al.	709/219
6,618,045	B1	9/2003	Lin	345/207

(Continued)

FOREIGN PATENT DOCUMENTS

CN	102110053	A	6/2011
CN	102141960	A	8/2011

(Continued)

OTHER PUBLICATIONS

"Monkeyrunner", A Simple monkeyrunner Program, the monkeyrunner API, Running monkeyrunner, monkeyrunner Built-in Help, and Extending monkeyrunner with Plugins, [no date], 6 pages.

(Continued)

Primary Examiner — Sarai Butler

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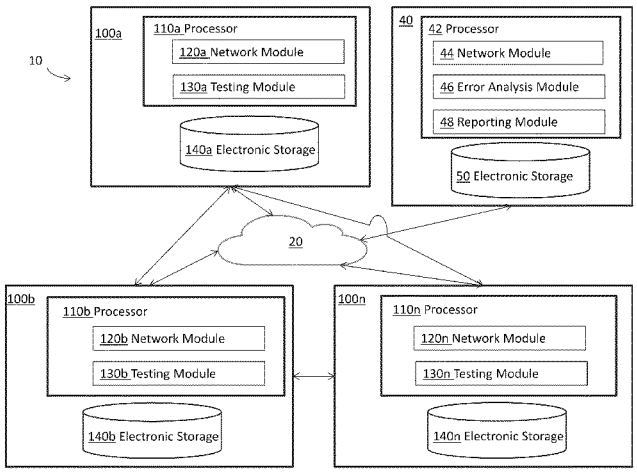
(57) **ABSTRACT**

Systems and methods for facilitating field testing of a test application are provided. In certain implementations, one or more metrics related to execution, at a mobile device, of one or more operations of the test application may be obtained. A determination of whether an error occurred with an operation of the one or more operations may be effectuated based on the one or more metrics. Error information relating to the error may be caused to be transmitted to one or more other mobile devices, wherein the error information includes information for replicating the error. Replication information relating to an attempt by the first other mobile device to replicate the error may be received back from at least a first other mobile device of the one or more other mobile devices. A determination of whether the first other mobile device replicated the error may be effectuated based on the replication information.

30 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

6,745,385	B1	6/2004	Lupu et al.	717/163
7,343,390	B2	3/2008	Cohen et al.	709/203
7,388,977	B2	6/2008	Wang et al.	382/141
7,483,984	B1	1/2009	Jonker et al.	709/226
7,769,009	B1	8/2010	Katzer et al.	370/390
8,271,608	B2	9/2012	Mahaffey et al.	709/217
8,296,445	B1	10/2012	Hackborn et al.	709/228
8,971,821	B2	3/2015	Schlub et al.	455/67.12
2003/0145317	A1	7/2003	Chamberlain	717/177
2004/0261248	A1	12/2004	Hwang	29/559
2006/0038581	A1	2/2006	Kanai	324/770
2006/0139269	A1	6/2006	Takeshita et al.	345/87
2006/0174162	A1	8/2006	Varadarajan et al.	714/38
2007/0186250	A1	8/2007	Carey	725/62
2007/0205751	A1	9/2007	Suzuki et al.	324/158.1
2007/0256114	A1	11/2007	Johnson et al.	725/139
2008/0013825	A1	1/2008	Nagatsuka et al.	382/153
2008/0274716	A1	11/2008	Fok et al.	455/410
2008/0316217	A1	12/2008	Khan	345/522
2008/0316368	A1	12/2008	Fritsch et al.	348/722
2009/0007074	A1	1/2009	Campion et al.	717/124
2009/0031015	A1	1/2009	Morgan et al.	709/223
2009/0124250	A1	5/2009	Topaltzas et al.	455/423
2009/0138579	A1	5/2009	Jung	709/221
2009/0203368	A1	8/2009	Marsyla et al.	455/418
2009/0249301	A1	10/2009	Kalla et al.	717/127
2009/0265035	A1	10/2009	Jenkinson et al.	700/259
2009/0307531	A1	12/2009	Karthikeyan et al.	714/38
2009/0312009	A1	12/2009	Fishel	455/425
2010/0080143	A1	4/2010	Topaltzas et al.	370/253
2010/0088423	A1	4/2010	Mazzagatte et al.	709/229
2010/0198402	A1	8/2010	Greer et al.	700/247
2010/0231738	A1	9/2010	Border et al.	348/222.1
2011/0080940	A1	4/2011	Bocharov et al.	375/240.01
2011/0087924	A1*	4/2011	Kandula	G06F 11/0709 714/26
2011/0113287	A1*	5/2011	Gururaj	G06F 11/0766 714/37
2011/0263243	A1	10/2011	Topaltzas et al.	455/423
2011/0288964	A1	11/2011	Linder et al.	705/27.1
2011/0296009	A1	12/2011	Baranov et al.	709/224
2011/0302454	A1	12/2011	Prophete et al.	714/38.1
2011/0304634	A1	12/2011	Urbach	345/501
2011/0310041	A1	12/2011	Williams et al.	345/173
2011/0320879	A1	12/2011	Singh et al.	714/38.1
2012/0015723	A1	1/2012	Lai	463/31
2012/0070090	A1	3/2012	Chang et al.	382/218
2012/0146956	A1	6/2012	Jenkinson	345/178
2012/0155292	A1	6/2012	Zazula et al.	370/252
2012/0188176	A1	7/2012	Uzelac et al.	345/173
2012/0191394	A1	7/2012	Uzelac et al.	702/79
2012/0198279	A1	8/2012	Schroeder	714/32
2012/0210242	A1	8/2012	Burckart et al.	715/744
2012/0221570	A1	8/2012	Kalavade	707/736
2012/0221893	A1	8/2012	Bai et al.	714/27
2012/0231785	A1	9/2012	Poon et al.	455/423
2012/0245918	A1	9/2012	Overton et al.	703/27
2012/0246515	A1	9/2012	Lusenhop et al.	714/32
2012/0254917	A1	10/2012	Burkitt et al.	725/40
2012/0266142	A1*	10/2012	Bokhari	G06F 11/3688 717/127
2012/0280934	A1	11/2012	Ha et al.	345/174
2012/0311569	A1	12/2012	Shah	718/1
2013/0002862	A1	1/2013	Waring et al.	348/143
2013/0132616	A1	5/2013	Worthington et al.	710/18
2013/0197862	A1	8/2013	Uzelac et al.	702/186
2013/0200917	A1	8/2013	Panagas	324/757.01
2014/0152584	A1	6/2014	Matthews et al.	345/173
2014/0156783	A1	6/2014	Matthews et al.	709/217
2014/0281714	A1	9/2014	Matthews et al.	714/27

FOREIGN PATENT DOCUMENTS

EP	2 369 481	9/2011
EP	2 492 814	8/2012
EP	2 515 526	10/2012
JP	2008-244688	10/2008
WO	WO 2011/128514	10/2011
WO	WO 2014/150306	9/2014

OTHER PUBLICATIONS

"Testdroid Recorder 2.0.9", Testing, Tools, Application Development Frameworks, and Mobile and Device Development, [no date], 3 pages.

"Metrico Wireless", printed from http://www.metricowireless.com, copyright 2003-2012, printed Nov. 7, 2012, 6 pages.

"Crittercism", printed from http://www.crittercism.com, printed Nov. 7, 2012, 9 pages.

"OpenSignal—Crowdsourced Coverage Maps—About Us", printed from http://opensignalcom/about.php, copyright 2012, printed Nov. 7, 2012, 1 page.

"Savage Minds", printed from http://www.savageminds.com, copyright 2011, printed Nov. 7, 2012, 19 pages.

Optofidelity Touch Panel Performance Test systems Brochure, dated Aug. 2013 available at http://www.optofidelity.com/wp-content/uploads/2013/09/OF_TPPT_general.pdf, 4 pages.

Optofidelity Test Automation Product Portfolio Brochure, dated May 2014 available at http://www.optofidelity.com/wp-content/uploads/2014/07/OF_ProductPortfolio_2014_En.pdf, 6 pages.

Video of Optofidelity Touch Panel Performance Tester, dated Oct. 15, 2012 available at https://www.youtube.com/watch?v=q_sxn1hZu78, 1 page.

Optofidelity Watchdog Brochure, dated Oct. 2013 available at http://www.optofidelity.com/wp-content/uploads/2013/11/OF_WatchDog_EN_www.pdf, 2 pages.

Optofidelity Measurement Services Brochure, dated Q1 2013 available at http://www.optofidelity.com/wp-content/uploads/2013/09/OF_MeasurementReport.pdf, 10 pages.

International Preliminary Report on Patentability mailed Sep. 24, 2015 for corresponding International Patent Application No. PCT/US2014/022910 (8 pages).

* cited by examiner

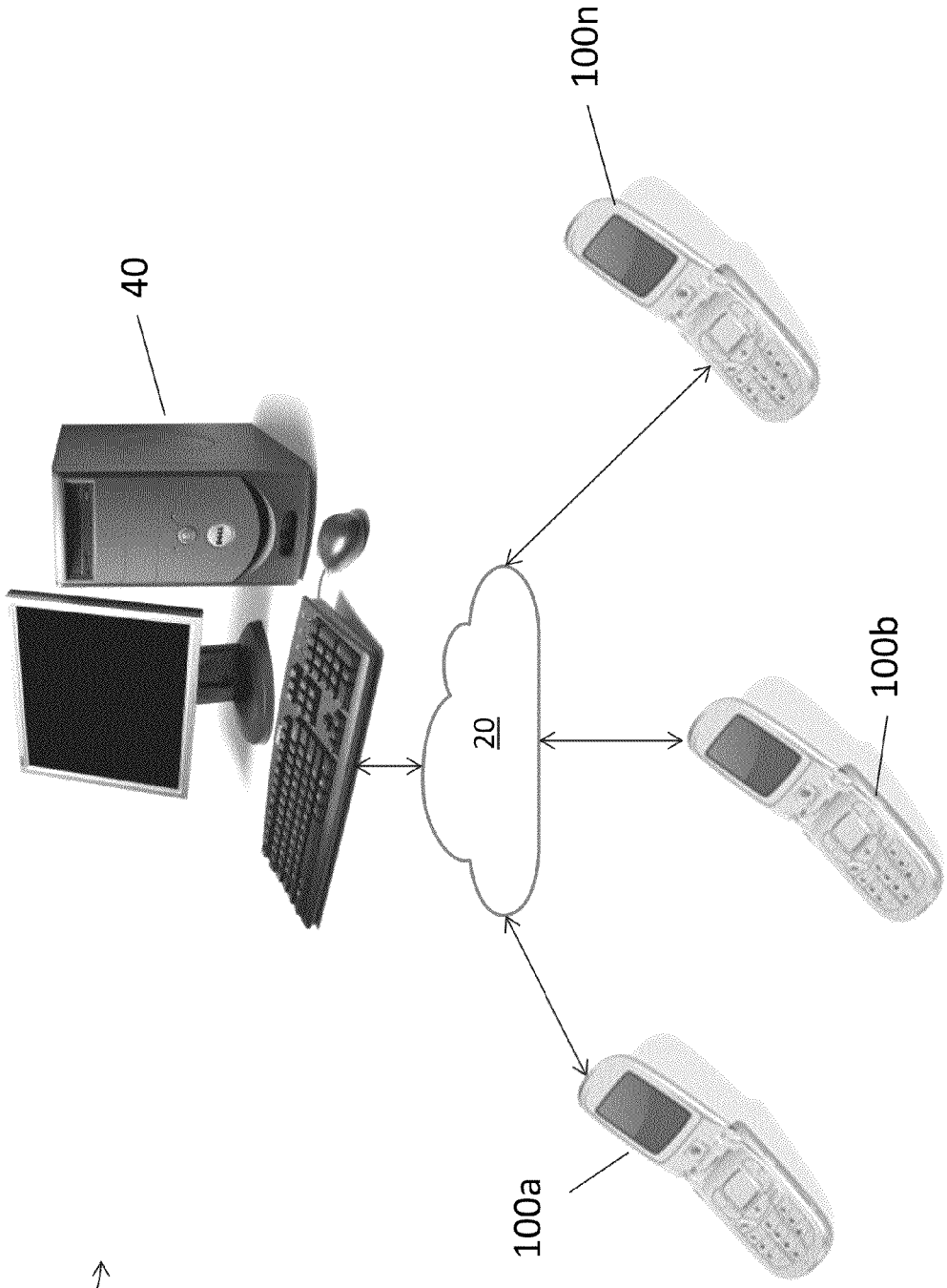


Fig. 1

10

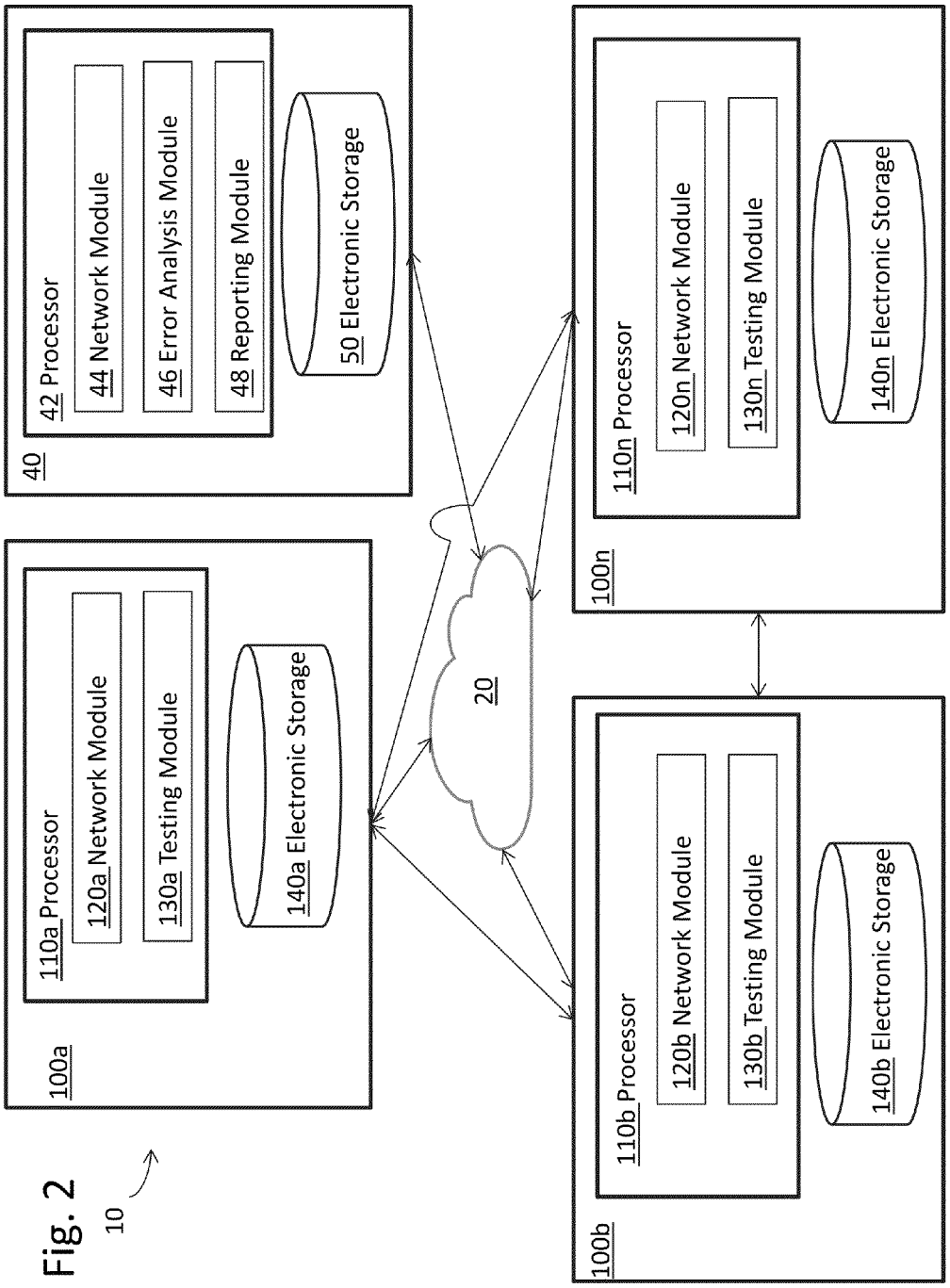

40
42 Processor
44 Network Module
46 Error Analysis Module
48 Reporting Module
50 Electronic Storage
100a
110a Processor
120a Network Module
130a Testing Module
140a Electronic Storage
20
100n
110n Processor
120n Network Module
130n Testing Module
140n Electronic Storage
100b
110b Processor
120b Network Module
130b Testing Module
140b Electronic Storage
10

Fig. 2

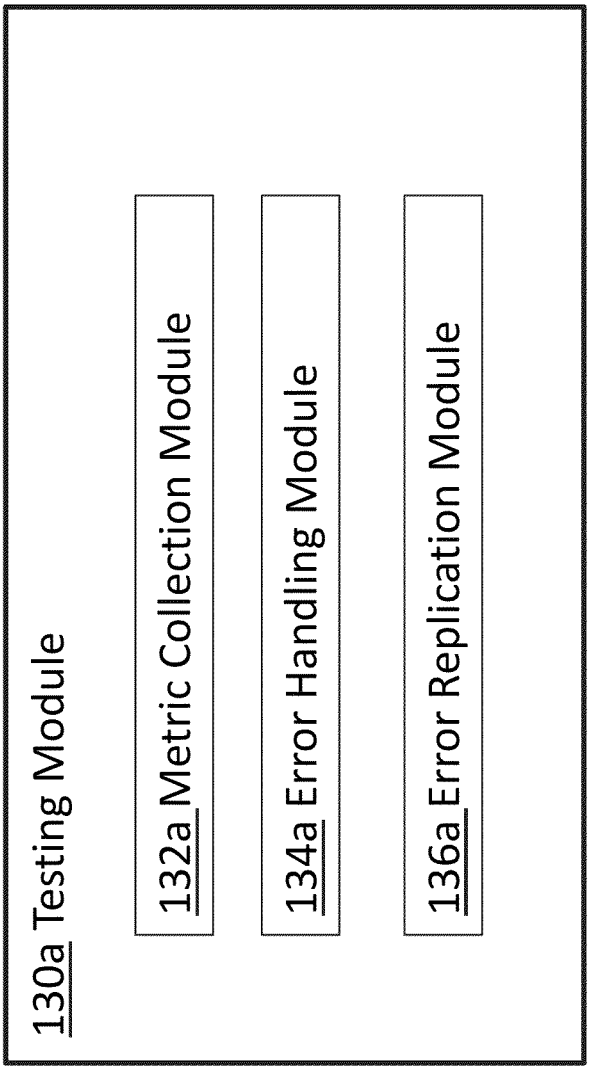

130a Testing Module
132a Metric Collection Module
134a Error Handling Module
136a Error Replication Module

Fig. 3

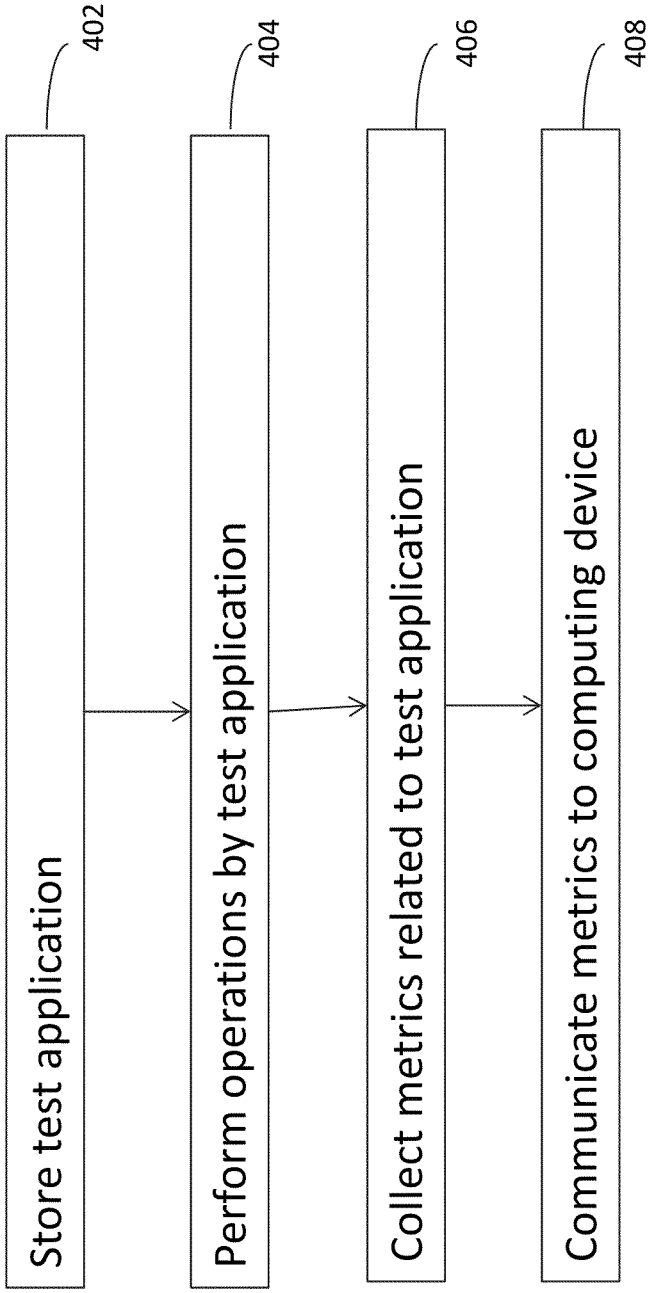

Store test application
402
Perform operations by test application
404
Collect metrics related to test application
406
Communicate metrics to computing device
408

Fig. 4

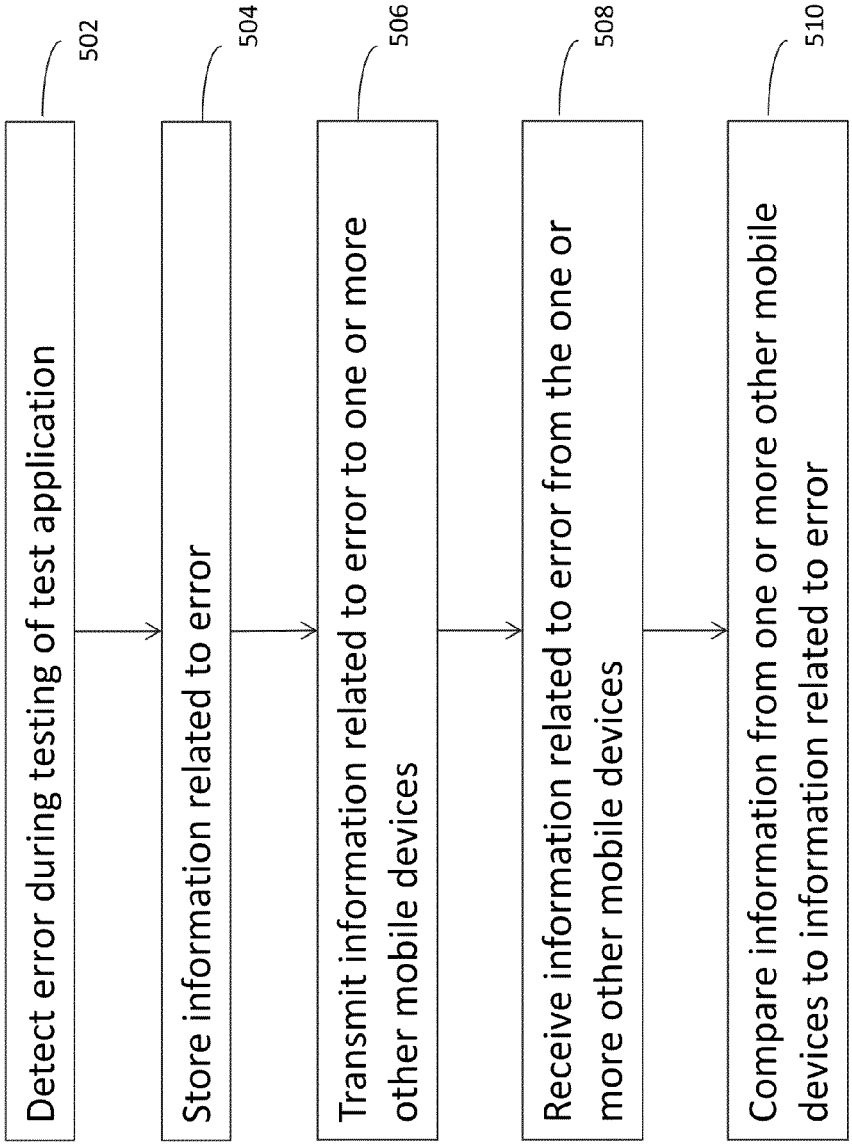

502
Detect error during testing of test application
504
Store information related to error
506
Transmit information related to error to one or more other mobile devices
508
Receive information related to error from the one or more other mobile devices
510
Compare information from one or more other mobile devices to information related to error

Fig. 5

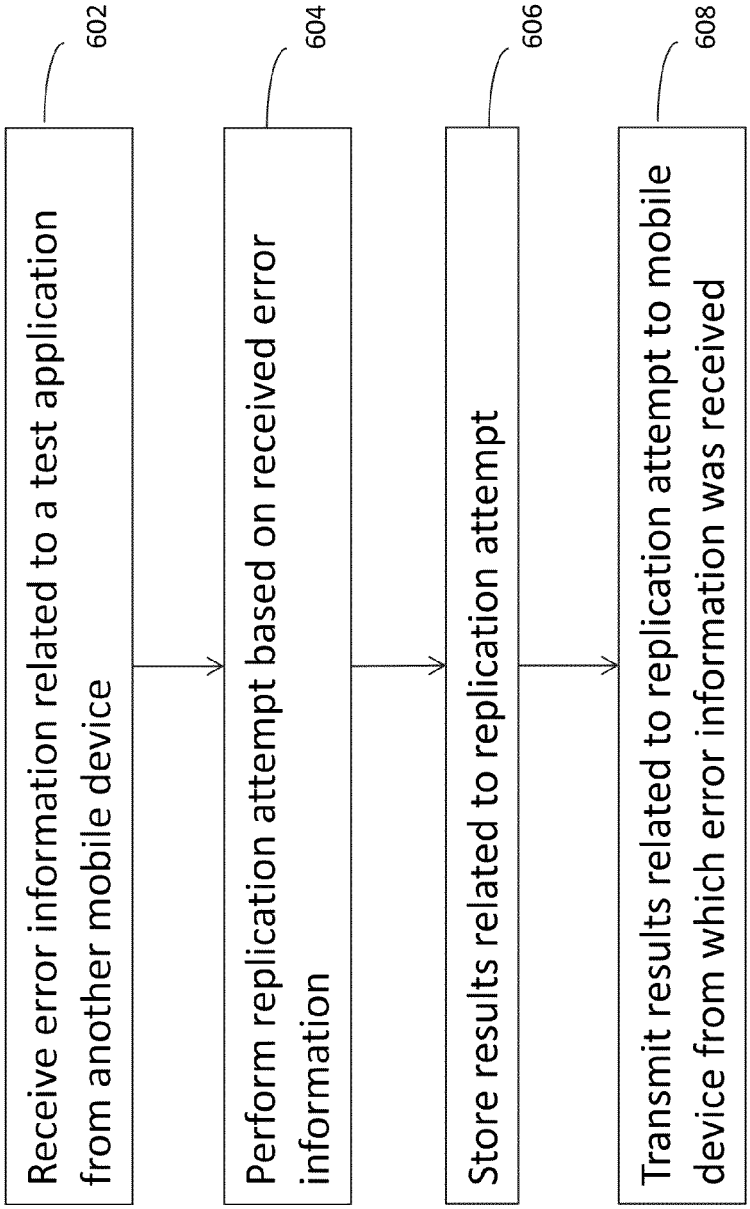

602
Receive error information related to a test application from another mobile device
604
Perform replication attempt based on received error information
606
Store results related to replication attempt
608
Transmit results related to replication attempt to mobile device from which error information was received

Fig. 6

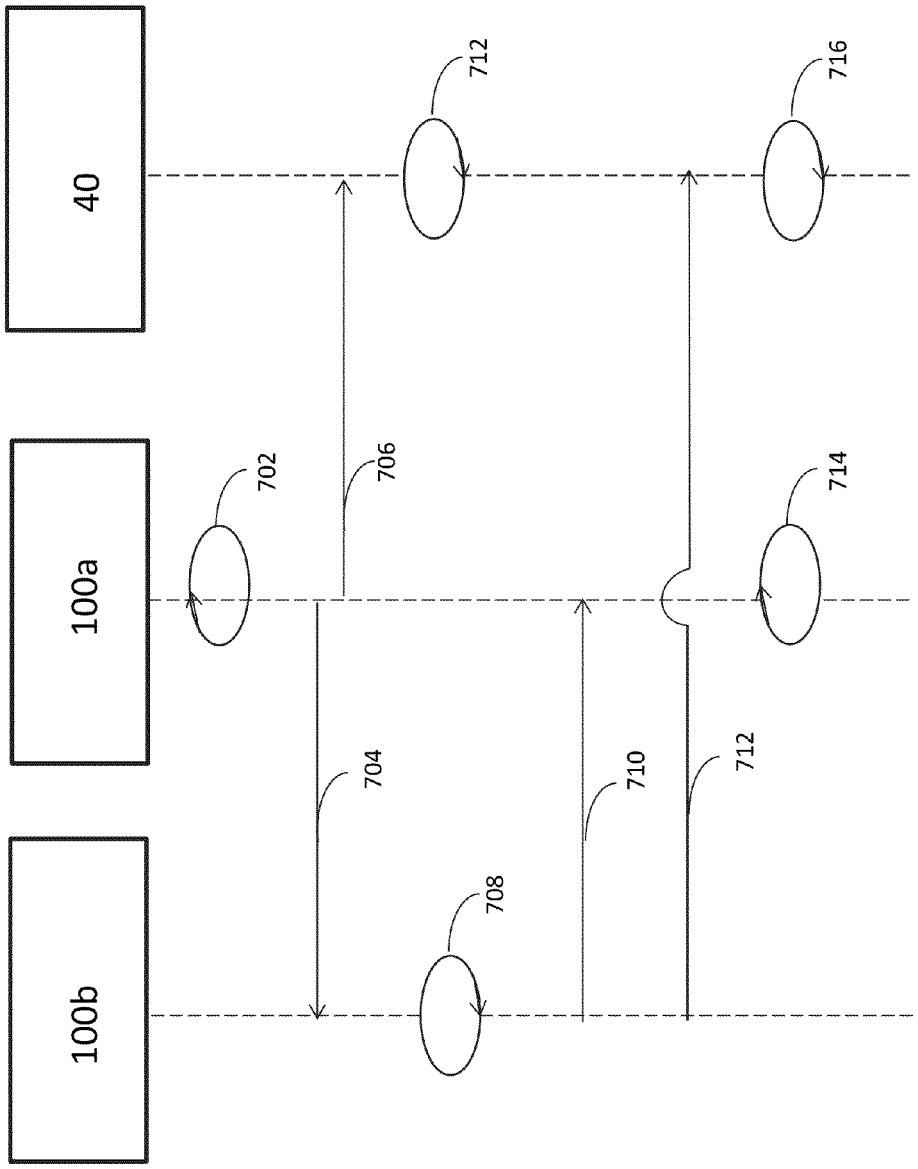


Fig. 7

SYSTEM AND METHOD FOR COORDINATING FIELD USER TESTING RESULTS FOR A MOBILE APPLICATION ACROSS VARIOUS MOBILE DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/837,851, entitled "System and Method for Coordinating Field User Testing Results for a Mobile Application Across Various Mobile Devices," filed Mar. 15, 2013, the content of which is hereby incorporated herein in its entirety by reference.

FIELD OF THE INVENTION

The invention relates to a system and method for facilitating field testing of a test application.

BACKGROUND OF THE INVENTION

Field user testing of mobile applications involves testing applications running on mobile devices in their respective working environments. For example, an application developer may select a group of users to test an application on various mobile devices with different hardware, and one or more versions of one or more operating systems. The users may report errors that they encounter during testing to the application developer.

Some conventional systems may employ semi-automated field user testing. For example, some conventional field user testing systems may facilitate the communication of an error that occurs during testing to a server in communication with the mobile device. Other conventional systems may communicate an error that occurred during testing to other mobile devices via instant messaging capabilities.

Conventional systems, whether employing user reporting or some type of automated reporting of errors, typically experience a lag between the occurrence of an error and analysis of that error. That lag may affect reproducibility of the error and the ability to determine how the error occurred.

Conventional systems for field user testing of mobile applications suffer from these and other drawbacks.

SUMMARY OF THE INVENTION

The invention solving these and other drawbacks of conventional systems relates to a system and method for coordinating field user testing results for a mobile application across various mobile devices.

According to an aspect of the invention, an application developer may wish to field test an application (a "test application") using a selection of mobile devices. The selection of mobile devices may comprise mobile devices having differing attributes such as, for example, different hardware, one or more operating systems, one or more versions of one or more operating systems, and/or other differing attributes.

The application developer may select a pre-determined number of mobile devices to which to deploy the test application. For example, the application developer may choose one or more sets of mobile devices, where the mobile devices in a given set differ by a single attribute. An attribute, for example, may comprise a hardware component, a software component, an operating system, a version of an operating system, and/or other attribute. In another example, the application developer may select a pre-determined number of mobile devices, where the devices may differ by more than one attribute.

A mobile device may test a test application by performing one or more operations by the test application. In one implementation, an application developer may prepare one or more test scripts for testing a test application. A test script may comprise a plurality of operations, an order in which the operations are to be performed, input data for one or more of the plurality of operations, and/or other information for testing a test application. The mobile devices on which the test application is deployed may use the one or more test scripts for testing the application. In one implementation, one or more users of the mobile devices may perform one or more operations by the test application, where the one or more operations may not be associated with a test script.

The mobile devices on which a test application is deployed may communicate with one another and with a computing device that may provide analysis related to the testing. For example, the mobile devices and the computing device may communicate with one another to track, replicate, and/or otherwise analyze an error that occurs during testing of the test application. The mobile devices and/or the computing device may determine characteristics associated with devices that encountered the error. The mobile devices may communicate by broadcasting data over a network (e.g., an Intranet), by transmitting data to a multicast socket at the computing device (which may be broadcast to all mobile devices able to connect to the multicast socket), by transmitting data to the computing device whereby the computing device transmits the data to the mobile devices, by transmitting data to each device included in a list of devices stored at the respective mobile devices, by requesting a list of mobile devices to which to transmit data from the computing device and transmitting data to each device including in that list, or in other manners.

According to an aspect of the invention, each mobile device in a selection of mobile devices may receive the test application. The test application may be stored on the mobile device before the mobile device is made available to a user to test the application, may be received via the computing device (e.g., via a download), may be received via the Internet, an intranet, and/or other network, may be received via an application store accessible via the mobile device, may be received via another application accessible via the mobile device, may be uploaded from an electronic storage media, may be received from one or more devices at a cloud computing environment that hosts the computing device, and/or may be obtained in other ways. In an implementation in which test scripts are used during testing of the test application, one or more test scripts associated with the test application may be stored at the mobile device, accessed from the computing device (e.g., via a download), accessed from another device via a network, uploaded from another device, obtained in a same or similar manner as the test application, and/or obtained in other ways.

In one implementation, the computing device configured to provide analysis regarding the test application may reside in a cloud computing environment. The computing device may be hosted and/or monitored by the application developer, by a third party service provider, and/or by another entity.

In one implementation, a third party service provider (or other entity) may facilitate field user testing of a test application. For example, the third party service provider may select mobile devices on which the test application is to be deployed, prepare one or more test scripts for testing the test application, facilitate the deployment of the test application to

a selection of mobile devices, and/or otherwise facilitate field user testing of the test application. The third party service provider may facilitate access, for the application developer, to data and analysis related to the test application. In one implementation, the third party service provider may facilitate field user testing for one or more test applications for one or more application developers.

According to an aspect of the invention, a system for coordinating field user testing results for a mobile application across various mobile devices may comprise a plurality of mobile devices configured to facilitate field user testing of a test application, and a computing device configured to provide analysis related to field user testing of the test application.

Mobile Device

A mobile device may include a non-transitory electronic storage media that stores an operating system, one or more physical processors configured to execute computer modules, and/or other components. The non-transitory electronic storage media may be configured to store a test application, metrics related to the test application, and/or other information related to the test application and/or the mobile device. The computer modules of the mobile device may comprise a network module configured to facilitate communication with other mobile devices and the computing device, a testing module configured to enable field user testing of the test application, and/or other modules.

The testing module (of the mobile device) may be configured as part of the operating system of the mobile device. For example, the testing module may comprise a data collection utility built into the framework of the operating system. In one non-limiting implementation, the mobile device may comprise an Android operating system. In this implementation, the testing module may be initiated and/or managed by the system_server process of the Android operating system. A binder process of the Android operating system may connect applications of the mobile device to the system_server process and the testing module via an Application Program Interface ("API"). The testing module may have same or similar privileges and access as the operating system to the test application and to data related to execution of the test application. The testing module may itself comprise various modules including, for example, a metric collection module, an error handling module, an error replication module, and/or other modules.

The metric collection module may be configured to collect and store, at the non-transitory electronic storage media, metrics from the execution of a test application and metrics from the operation of the mobile device. For example, for each operation of the test application performed, the metric collection module may collect and/or store information related to one or more prior operations performed, a state of the test application, a state of the mobile device, one or more parameters associated with the operation, one or more inputs to the operation, one or more outputs from the operation, a result of the operation, an associated test script, and/or other information related to the operation. The operations performed by the test application may correspond to one or more operations in one more test scripts related to the test application. For example, the test scripts may be performed by a user of the mobile device, may be automatically executed by the mobile device, may be automatically executed by the testing module, and/or may be performed in other ways. In one implementation, one or more of operations performed may be random operations that do not correspond to a test script.

The metric collection module may collect and store, at the non-transitory electronic storage media, information related to operation of the mobile device. For example, the metric collection module may collect and store information related to when any application (including, for example, the test application) crashes on the mobile device, when the mobile device is unable to perform any operation related to any application, whether a reset of the operating system occurred, device temperature, battery usage, cellular data usage, Wi-Fi data usage, network state, whether any phone calls were dropped, information related to logs stored via operation of the mobile device, and/or other information related to operation of the mobile device.

The metric collection module may transmit information related to execution of the test application and operation of the mobile device to the computing device. For example, the metric collection module may transmit information at predetermined intervals, based on a request by the computing device, based on a request by a user of the mobile device, and/or in response to other information.

The error handling module of the testing module may be configured to detect errors that occur in the test application, transmit information relating to detected errors to other mobile devices, receive information relating to replication attempts from other mobile devices, determine whether an error occurred at one or more other mobile devices, determine characteristics relating to detected errors based on replication information from other mobile devices, and/or perform other functionality related to error handling.

When an operation is associated with a test script, the non-transitory electronic storage media may store information relating to expected results based on execution of the operation. The error handling module may compare information collected by the metric collection module relating to an operation and information stored at the non-transitory electronic storage media relating to the operation. In response to a determination that information collected by the metric collection module does not match information relating to expected results, the error handling module may indicate that an error occurred with the operation.

The non-transitory electronic storage media may store information related to one or more events that indicate that an error occurred. The information related to the one or more events may indicate that an error occurred with an operation of the test application, with operation of the mobile device, and/or that another type of error occurred. The error handling module may compare information collected by the metric collection module relating to the operation and information stored at the non-transitory electronic storage media relating to the one or more events. In response to a determination that information collected by the metric collection module matches information relating to one or more events, the error handling module may indicate that an error occurred with the operation.

In response to an indication by the error handling module that an error occurred, the error handling module may augment stored information relating to the operation with an indication that an error occurred with the operation. In one implementation, the non-transitory electronic storage media may store information related to the error separately from information collected by the metric collection module. For example, the non-transitory electronic storage media may store error information related to the error in an error log. The error information may include, for example, one or more of an identification of the test application, an identification of the operation at which the error occurred, one or more parameters associated with the operation at which the error occurred, input data for the operation at which the error occurred, output data for the operation at which the error occurred, one

or more results of the operation at which the error occurred, information related to one or more operations that occurred before the operation at which the error occurred, one or more parameters for each of the one or more operations, input data for each of the one or more operations, output data for each of the one or more operations, a state of the test application when the error occurred, an associated test script, and/or other information related to the error. In one implementation, the error handling module may transmit error information related to the error to the computing device in response to a determination that the error occurred, at pre-determined intervals during execution of the test application, and/or in response to other information.

In one implementation, a format for error information may comprise, for example, a first portion related to a magic number, a second portion related to a timestamp, a third portion related to a type of data, a fourth portion related to length of the record, a fifth portion related to context specific data, and/or other portions that describe a format for the record. For example, a timestamp may comprise a number of milliseconds represented as a 48 bit unsigned integer. A type of data may be a 16-bit unsigned integer, a 16 bit signed integer, a string, and/or other type of data. A length of the record may be represented as a 16-bit unsigned integer. Context-specific data may comprise, for example, logcat, kmsg, and/or other context-specific data.

In response to a determination that an error occurred with an operation, the error handling module may transmit error information relating to the error to other mobile devices. The error handling module may transmit error information relating to the error to mobile devices included in a list stored in the non-transitory electronic storage media. In one implementation, the error handling module may request, from the computing device, a list of mobile devices to which to transmit error information. In one implementation, the error handling module may broadcast the error information over a network (e.g., an intranet) such that all other devices connected to the network may receive the error information. In one implementation, the error handling module may transmit data to a multicast socket at the computing device via which the data may be broadcast to all mobile devices able to connect to the multicast socket.

In response to transmission of the error information to other mobile devices, the error handling module may receive replication information from one or more other mobile devices regarding the error information. In one implementation, the computing device may receive replication information from one or more other mobile devices. The replication information may comprise information related to results of an attempt to replicate the error by other mobile devices. The replication information may include information relating to the mobile device from which the replication information was received. For example, the replication information may include information relating to attributes of the mobile device from which the replication information was received, such as, for example, hardware of the mobile device, operating system, operating system version, and/or other attributes. The error handling module may determine whether another mobile device was able to replicate the error based on a comparison of the replication information received from the other mobile device and the error information relating to the operation at which the error occurred.

In response to a determination of which mobile devices were able to replicate the error, the error handling module may determine characteristics relating to the error. For example, the error handling module may determine that the error may occur at mobile devices that share one or more attributes such as, for example, a hardware component, an operating system, a version of an operating system, and/or other attributes.

The error replication module of the testing module may be configured to receive error information to replicate an error that occurred at another mobile device, store results related to an error replication attempt, send the results to the another mobile device and/or to the computing device, and/or perform other functionality related to error replication.

The error replication module may receive error information from another mobile device. The error information may comprise, for example, an identifier relating to a test application, an operation during which the error occurred, information relating to one or more operations to be executed to reproduce the error, state information relating to the test application when the error occurred, state information relating to the mobile device when the error occurred, data inputs to the operation and to any operations that preceded the operation at which the error occurred, a test script comprising the operations executed (and corresponding data inputs) to reproduce the error, and/or other information related to the error and/or its reproduction.

In response to a determination that the error information includes information related to a test script, the error replication module may attempt to automatically replicate the error by executing the relevant operations set forth in the test script.

In one implementation, the error information may comprise a link to the test application. In response to receipt of user input that accesses the link to the test application, the error replication module may open the test application. The error replication module may automatically execute the operations of the test application using data inputs received in the error information to attempt to reproduce the error. In one implementation, the error replication module may open the test application and may display instructions regarding how to replicate the error. The error replication module may receive user input to execute the operations to reproduce the error.

In response to the execution of an operation by the error replication module (or a mobile device), the metric collection module of the mobile device may collect information relating to the operation. Responsive to the error replication module executing the operation at which the error occurred, the error replication module may communicate the information collected by the metric collection module for the operation to the mobile device from which it received the error information.

A mobile device may act as a sending device when an error occurs during testing of the test application at the mobile device. A mobile device may also act as a receiving device when receiving information related to an error that occurred during testing of the test application at another mobile device. In response to a determination that an error occurred at a sending device, one or more mobile devices may act as respective one or more receiving devices. A receiving device may perform the functionality of the error replication module of the testing module. Both a sending device and a receiving device may perform some or all of the functionality of the error handling module of the testing module.

Computing Device

According to an aspect of the invention, a computing device may comprise a non-transitory electronic storage media configured to store information related to field user testing of one or more test applications, one or more physical processors configured to execute one or more computer modules, and/or other components. The one or more computer modules of the computing device may comprise, for example, a network module configured to facilitate communication

with a network and with a plurality of mobile devices, an error analysis module configured to provide analysis related to a test application, a reporting module configured to facilitate analysis and report information related to information stored at the non-transitory electronic storage media, and/or other modules.

The non-transitory electronic storage media (of the computing device) may be configured to store one or more test applications, information related to the one or more mobile devices, information related to one or more operations performed by the test application at one or more mobile devices, error information received from one or more mobile devices, replication information received from one or more mobile devices, data related to analysis of the one or more test applications, and/or other information related to field user testing of the one or more test applications. In one implementation, the non-transitory electronic storage media may comprise an error log configured to store information relating to one or more errors that occurred during testing of a test application. In one implementation, the non-transitory electronic storage media may store a list of mobile devices to which the test application is deployed. The list may include attributes related to one or more of the mobile devices.

For each test application, the non-transitory electronic storage media may store information relating to expected results based on execution of operations of the test application. The non-transitory electronic storage media may store information related to one or more events that indicate that an error occurred. The information related to the one or more events may indicate that an error occurred with an operation of the test application, with operation of the mobile device, and/or that another type of error occurred.

The error analysis module may be configured to receive, from a sending device, information related to one or more operations performed by the test application at the sending device. For example, the error analysis module may be configured to receive the information from the sending device at pre-determined intervals, in response to a request for the information transmitted from the computing device to the sending device, and/or in response to other information. In one implementation, the error analysis module may be configured to transmit the received information to one or more receiving devices.

The error analysis module may compare received information relating to an operation and information stored at the non-transitory electronic storage media relating to the operation. In response to a determination that received information does not match stored information relating to expected results, the error analysis module may indicate that an error occurred with the operation.

The error analysis module may compare received information and information stored at the non-transitory electronic storage media relating to the one or more events. In response to a determination that received information matches information relating to one or more events, the error analysis module may indicate that an error occurred with the operation.

The error analysis module may be configured to also receive error information related to an error that occurred with an operation of the test application.

The error analysis module may store, at an error log of the non-transitory electronic storage media, received information relating to an operation at which an error occurred, received error information, and/or other information relating to an error that occurred at the sending device. The computing device may facilitate access, for an application developer associated with a test application, to information at the error log associated with the test application.

In one implementation, the error analysis module may receive replication information from one or more receiving devices. The replication information may comprise information related to results of an attempt to replicate the error by the one or more receiving devices. The replication information may include information relating to the receiving device from which the replication information was received. For example, the replication information may include information relating to attributes of the receiving device from which the replication information was received, such as, for example, hardware of the mobile device, operating system, operating system version, and/or other attributes. In one implementation, a list of receiving devices accessible by the error analysis module may include information relating to attributes of the respective receiving devices. The error analysis module may determine whether a receiving device was able to replicate the error based on a comparison of the replication information received from the receiving device and corresponding error information.

In one implementation, the error analysis module may compare replication information received from one or more receiving devices to which the error information was transmitted. Based on which receiving devices were able to replicate the error, the error analysis module may determine attributes of the mobile devices associated with the error. For example, the error analysis module may determine that the error may occur at mobile devices that share one or more attributes such as, for example, a specific piece of hardware, a type of operating system, a version of an operating system, and/or other attributes. The error analysis module may store, at the error log, information relating to characteristics relating to the error. In one implementation, the error analysis module may augment information stored at the error log relating to the error with information relating to attributes associated with devices that produce the error.

The reporting module may be configured to facilitate analysis and report information related to information stored at the non-transitory electronic storage media. For example, the reporting module may be configured to provide, for a test application, one or more reports related to errors that occurred during testing of the test application, one or more reports comprising information from the error log of the non-transitory electronic storage media of the computing device, one or more reports related to error information from a sending device and replication information from one or more receiving devices, and/or other information related to field user testing of the test application. In one implementation, the reporting module may be configured to prepare and/or display reports including statistics regarding field user testing of one or more test applications. The types of reports prepared by reporting module are not limited to the examples described herein.

In one implementation, reporting module may facilitate a search for information related to field user testing of one or more test applications. For example, the reporting module may facilitate a search for errors that occurred at mobile devices with a set of specific attributes. In another example, the reporting module may facilitate a search for errors that were replicated in other mobile devices. The types of searches facilitated by the reporting module are not limited to the examples described herein.

The reporting module may generate reports relating to field user testing of one or more test applications at pre-determined time intervals, in response to a request by an application

developer, in response to a request by a user of a mobile device, upon completion of field user testing for a test application, and/or at other times.

These and other aspects, features, and characteristics of the present invention, as well as the methods of operation and functions of the related elements of structure and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention. As used in the specification and in the claims, the singular form of "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an exemplary diagram of a system for coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

FIG. **2** illustrates an exemplary diagram of a system for coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

FIG. **3** illustrates an exemplary diagram of a testing module, according to an aspect of the invention.

FIG. **4** illustrates a flowchart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

FIG. **5** illustrates a flowchart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

FIG. **6** illustrates a flow chart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

FIG. **7** illustrates a data flow diagram of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention.

DETAILED DESCRIPTION

FIG. **1** illustrates an exemplary diagram of a system **10** for coordinating field user testing results for a mobile application across various mobile devices. According to an aspect of the invention, system **10** may comprise a plurality of mobile devices **100***a*, **100***b*, . . . **100***n* configured to facilitate field user testing of a test application, and a computing device **40** configured to provide analysis related to field user testing of the test application. According to an aspect of the invention, an application developer may wish to field test an application (a "test application") using a selection of mobile devices **100***a*, **100***b*, . . . **100***n*. Mobile devices **100***a*, **100***b*, . . . **100***n* may have differing attributes such as, for example, different hardware, one or more operating systems, one or more versions of one or more operating systems, and/or other differing attributes.

Mobile devices **100***a*, **100***b*, . . . **100***n* (on which a test application is deployed) may communicate with one another and with computing device **40**. Computing device **40** may provide analysis related to the testing. For example, mobile devices **100***a*, **100***b*, . . . **100***n* and computing device **40** may communicate with one another to track, replicate, and/or otherwise analyze an error that occurs during testing of the test application. Mobile devices **100***a*, **100***b*, . . . **100***n* and/or computing device **40** may determine characteristics associated with mobile devices **100***a*, **100***b*, . . . **100***n* that encountered the error. Mobile devices **100***a*, **100***b*, . . . **100***n* may communicate by broadcasting data over a network **20**, by transmitting data to a multicast socket at computing device **40** (which may be broadcast to all mobile devices **100***a*, **100***b*, . . . **100***n* able to connect to the multicast socket), by transmitting data to computing device **40** whereby computing device **40** transmits the data to the mobile devices **100***a*, **100***b*, . . . **100***n*, by transmitting data to each device included in a list of devices stored at respective mobile devices **100***a*, **100***b*, . . . **100***n*, by requesting a list of mobile devices to which to transmit data from computing device **40** and transmitting data to each device including in that list, or in other manners.

According to an aspect of the invention, each mobile device in a selection of mobile devices **100***a*, **100***b*, . . . **100***n* may receive the test application. For example, the test application may be stored on mobile device **100***a* before mobile device **100***a* is made available to a user to test the application, may be received via computing device **40** (e.g., via a download), may be received via network **20**, may be received via an application store accessible via mobile device **100***a*, may be received via another application accessible via mobile device **100***a*, may be uploaded from an electronic storage media, may be received from one or more devices at a cloud computing environment that hosts computing device **40**, and/or may be obtained in other ways. In an implementation in which test scripts are used during testing of the test application, one or more test scripts associated with the test application may be stored at mobile device **100***a*, accessed from computing device **40** (e.g., via a download), accessed from another device via a network, uploaded from another device, obtained in a same or similar manner as the test application, and/or obtained in other ways.

In one implementation, computing device **40** configured to provide analysis regarding the test application may reside in a cloud computing environment. Computing device **40** may be hosted and/or monitored by an application developer, by a third party service provider, and/or by another entity.

FIG. **2** illustrates an exemplary diagram of system **10**, comprising plurality of mobile devices **100***a*, **100***b*, . . . , **100***n* configured to facilitate field user testing of a test application, and computing device **40** configured to provide analysis related to field user testing of the test application.

Mobile Device

Mobile device **100***a* may include a non-transitory electronic storage media **140***a* that stores an operating system, one or more physical processors **110***a* configured to execute computer modules, and/or other components. Non-transitory electronic storage media **140***a* may be configured to store a test application, metrics related to the test application, and/or other information related to the test application, and/or mobile device **100***a*. The computer modules of mobile device **100***a* may comprise a network module **120***a* configured to facilitate communication with other mobile devices and computing device **40**, a testing module **130***a* configured to enable field user testing of the test application, and/or other modules.

Mobile device **100***a* may be any mobile device such as, for example, a personal digital assistant, smart phone, tablet, and/or other mobile device. Mobile device **100***a* may be capable of communicating with one or more mobile devices (e.g., mobile device **100***b*, . . . , **100***n*) and one or more

computing devices (e.g., computing device **40**) over network **20**. Network **20** may be, for example, a public or private network, or any other suitable communication channel. Mobile device **100***a* may also include other components typically found in mobile devices, including, for example, user input features (e.g., a touch screen, microphone, keyboard, and/or other user input features), speakers, an antenna (and the corresponding signal processing capabilities), and/or other features. Other mobile devices (e.g., mobile device **100***b*, . . . , **100***n*) may include similar features.

Processor **110***a* may provide information processing capabilities within mobile device **100***a*. As such, processor **110***a* may include one or more of a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information. Although processor **110***a* is shown in FIG. **2** as a single entity, this is not intended to be limiting, as processor **110***a* may include a plurality of processors operating in coordination or cooperation. Processor **110***a* may be configured to execute modules **120***a* and/or **130***a*. Processor **110***a* may be configured to execute modules **120***a* and/or **130***a* by software, hardware, firmware, some combination of software, hardware, and/or firmware, and/or other mechanisms for configuring processing capabilities on processor **110***a*.

It should be appreciated that although modules **120***a* and **130***a* are illustrated in FIG. **2** as being co-located within a single computing device, in implementations in which processor **110***a* includes multiple processing units, one or more of modules **120***a* and/or **130***a* may be located remotely from the other modules. The description of the functionality provided by different modules **120***a* and/or **130***a* described below is for illustrative purposes, and is not intended to be limiting, as any of modules **120***a* and/or **130***a* may provide more or less functionality than is described. For example, one or more of modules **120***a* and/or **130***a* may be eliminated, and some or all of its functionality may be provided by other ones of modules **120***a* and/or **130***a*. As another example, processor **110***a* may be configured to execute one or more additional modules that may perform some or all of the functionality attributed below to one of modules **120***a* and/or **130***a*.

Non-transitory electronic storage media **140***a* may comprise electronic storage media that electronically stores information non-transiently. Electronic storage media of non-transitory electronic storage media **140***a* may include one or both of system storage that is provided integrally (i.e., substantially non-removable) with mobile device **100***a* and/or removable storage that is removably connectable to mobile device **100***a* via, for example, a port (e.g., a USB port, a firewire port, etc.) or a drive (e.g., a disk drive, etc.). Non-transitory electronic storage media **140***a* may include one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. Non-transitory electronic storage media **140***a* may include one or more virtual storage resources (e.g., cloud storage, a virtual private network, and/or other virtual storage resources). Non-transitory electronic storage media **140***a* may store software algorithms, information determined by processor **110***a*, information received from other mobile devices **100***b*, . . . , **100***n*, information received from computing device **40**, and/or other information that enables mobile device **100***a* to function as described herein.

In one implementation, testing module **130***a* (of mobile device **100***a*) may be configured as part of the operating system of mobile device **100***a*. For example, testing module **130***a* may comprise a data collection utility built into the framework of the operating system. In one non-limiting implementation, mobile device **100***a* may comprise an Android operating system. In this implementation, testing module **130***a* may be initiated and/or managed by the system_server process of the Android operating system. A binder process of the Android operating system may connect applications of the mobile device to the system_server process and testing module **130***a* via an Application Program Interface ("API"). Testing module **130***a* may have same or similar privileges and access as the operating system to the test application and to data related to execution of the test application. As shown in FIG. **3**, testing module **130***a* may itself comprise various modules including, for example, a metric collection module **132***a*, an error handling module **134***a*, an error replication module **136***a*, and/or other modules.

Metric collection module **132***a* (of testing module **130***a*) may be configured to collect and store, at non-transitory electronic storage media **140***a*, metrics from the execution of a test application, and metrics from the operation of mobile device **100***a*. For example, for each operation of the test application performed, metric collection module **132***a* may collect and/or store information related to one or more prior operations performed, a state of the test application, a state of mobile device **100***a*, one or more parameters associated with the operation, one or more inputs to the operation, one or more outputs from the operation, a result of the operation, an associated test script, and/or other information related to the operation. The operations performed by the test application may correspond to one or more operations in one more test scripts related to the test application. For example, the test scripts may be performed by a user of mobile device **100***a*, may be automatically executed by mobile device **100***a*, may be automatically executed by testing module **130***a*, and/or may be performed in other ways. In one implementation, one or more operations performed may be random operations that do not correspond to a test script.

Metric collection module **132***a* may collect and store, at non-transitory electronic storage media **140***a*, information related to operation of mobile device **100***a*. For example, metric collection module **132***a* may collect and store information related to when an application (including, for example, the test application) crashes on the mobile device **100***a*, when mobile device **100***a* is unable to perform any operation related to any application, whether a reset of the operating system occurred, device temperature, battery usage, cellular data usage, Wi-Fi data usage, network state, whether any phone calls were dropped, information related to logs stored via operation of the mobile device, and/or other information related to operation of mobile device **100***a*.

Metric collection module **132***a* may transmit information related to execution of the test application and operation of mobile device **100***a* to computing device **40**. For example, metric collection module **132***a* may transmit information at pre-determined intervals, based on a request by computing device **40**, based on a request by a user of mobile device **100***a*, and/or in response to other information or events.

Error handling module **134***a* of testing module **130***a* may be configured to detect errors that occur in the test application, transmit information relating to detected errors to other mobile devices **100***b*, . . . , **100***n*, receive information relating to replication attempts from other mobile devices **100***b*, . . . **100***n*, determine whether an error occurred at one or more other mobile devices **100***b*, . . . **100***n*, determine characteris-

tics relating to detected errors based on replication information from other mobile devices **100***b*, . . . **100***n*, and/or perform other functionality related to error handling.

When an operation is associated with a test script, non-transitory electronic storage media **140***a* may store information relating to expected results based on execution of the operation. Error handling module **134***a* may compare information collected by metric collection module **132***a* relating to an operation and information stored at non-transitory electronic storage media **140***a* relating to the operation. In response to a determination that information collected by metric collection module **132***a* does not match information relating to expected results, error handling module **134***a* may indicate that an error occurred with the operation.

Non-transitory electronic storage media **140***a* may store information related to one or more events that indicate that an error occurred. The information related to the one or more events may indicate that an error occurred with an operation of the test application, with operation of mobile device **100***a*, and/or that another type of error occurred. Error handling module **134***a* may compare information collected by metric collection module **132***a* relating to the operation and information stored at non-transitory electronic storage media **140***a* relating to the one or more events. In response to a determination that information collected by metric collection module **132***a* matches information relating to one or more events, the error handling module **134***a* may indicate that an error occurred with the operation.

In response to an indication by error handling module **134***a* that an error occurred, error handling module **134***a* may augment stored information relating to the operation with an indication that an error occurred with the operation. In one implementation, non-transitory electronic storage media **140***a* may store information related to the error separately from information collected by metric collection module **132***a*. For example, non-transitory electronic storage media **140***a* may store error information related to the error in an error log. The error information may include, for example, one or more of an identification of the test application, an identification of the operation at which the error occurred, one or more parameters associated with the operation at which the error occurred, input data for the operation at which the error occurred, output data for the operation at which the error occurred, one or more results of the operation at which the error occurred, information related to one or more operations that occurred before the operation at which the error occurred, one or more parameters for each of the one or more operations, input data for each of the one or more operations, output data for each of the one or more operations, a state of the test application when the error occurred, an associated test script, and/or other information related to the error. In one implementation, error handling module **134** may transmit error information related to the error to computing device **40** in response to a determination that the error occurred, at predetermined intervals during execution of the test application, and/or in response to other information.

In one implementation, a format for error information may comprise, for example, a first portion related to a magic number, a second portion related to a timestamp, a third portion related to a type of data, a fourth portion related to length of the record, a fifth portion related to context specific data, and/or other portions that describe a format for the record. For example, a timestamp may comprise a number of milliseconds represented as a 48 bit unsigned integer. A type of data may be a 16-bit unsigned integer, a 16 bit signed integer, a string, and/or other type of data. A length of the record may be represented as a 16-bit unsigned integer. Context-specific data may comprise, for example, logcat, kmsg, and/or other context-specific data.

In response to a determination that an error occurred with an operation, error handling module **134***a* may transmit error information relating to the error to other mobile devices **100***b*, . . . , **100***n*. Error handling module **134***a* may transmit error information relating to the error to mobile devices **100***b*, . . . , **100***n* included in a list stored in non-transitory electronic storage media **140***a*. In one implementation, error handling module **134***a* may request, from computing device **40**, a list of mobile devices **100***b*, . . . , **100***n* to which to transmit error information. In one implementation, error handling module **134***a* may broadcast the error information over network **20** such that all other devices **100***b*, . . . , **100***n* connected to network **20** may receive the error information. In one implementation, error handling module **134***a* may transmit data to a multicast socket at computing device **40** via which the data may be broadcast to all mobile devices **100***b*, . . . , **100***n* able to connect to the multicast socket.

In response to transmission of the error information to other mobile devices **100***b*, . . . , **100***n*, error handling module **134***a* may receive replication information from one or more other mobile devices **100***b*, . . . , **100***n* regarding the error information. In one implementation, computing device **40** may receive replication information from one or more other mobile devices **100***b*, . . . , **100***n*. The replication information may comprise information related to results of an attempt to replicate the error by other mobile devices **100***b*, . . . , **100***n*. The replication information may include information relating to the mobile device **100***n* from which the replication information was received. For example, the replication information may include information relating to attributes of mobile device **100***n* from which the replication information was received, such as, for example, hardware of mobile device **100***n*, operating system, operating system version, and/or other attributes. Error handling module **134***a* may determine whether another mobile device **100***n* was able to replicate the error based on a comparison of the replication information received from other mobile device **100***n* and the error information relating to the operation at which the error occurred.

In response to a determination of which mobile devices **100***b*, . . . , **100***n* were able to replicate the error, error handling module **134***a* may determine characteristics relating to the error. For example, error handling module **134***a* may determine that the error may occur at mobile devices **100***b*, . . . , **100***n* that share one or more attributes such as, for example, a hardware component, an operating system, a version of an operating system, and/or other attributes.

Error replication module **136***a* of testing module **130***a* may be configured to receive error information to replicate an error that occurred at another mobile device **100***n*, store results related to an error replication attempt, send the results to another mobile device **100***n* and/or to computing device **40**, and/or perform other functionality related to error replication.

Error replication module **136***a* may receive error information from another mobile device **100***n*. The error information may comprise, for example, an identifier relating to a test application, an operation during which the error occurred, information relating to one or more operations to be executed to reproduce the error, state information relating to the test application when the error occurred, state information relating to mobile device **100***n* when the error occurred, data inputs to the operation and to any operations that preceded the operation at which the error occurred, a test script comprising the operations executed (and corresponding data inputs) to reproduce the error, and/or other information related to the error and/or its reproduction.

In response to a determination that the error information includes information related to a test script, error replication module **136***a* may attempt to automatically replicate the error by executing the relevant operations set forth in the test script.

In one implementation, the error information may comprise a link to the test application. In response to receipt of user input that accesses the link to the test application, error replication module **136***a* may open the test application. Error replication module **136***a* may automatically execute the operations of the test application using data inputs received in the error information to attempt to reproduce the error. In one implementation, error replication module **136***a* may open the test application and may display instructions regarding how to replicate the error. The error replication module **136***a* may receive user input to execute the operations to reproduce the error.

In response to the execution of an operation by error replication module **136***a*, metric collection module **132***a* of mobile device **100***a* may collect information relating to the operation. Responsive to error replication module **136***a* executing the operation at which the error occurred, error replication module **136***a* may communicate the information collected by metric collection module **132***a* for the operation to mobile device **100***n* from which it received the error information.

Referring again to FIG. **2**, a mobile device may act as a sending device **100***a* when an error occurs during testing of the test application at the mobile device. A mobile device may also act as a receiving device **100***n* when receiving information related to an error that occurred during testing of the test application at sending device **100***a*. In response to a determination that an error occurred at sending device **100***a*, one or more mobile devices may act as respective one or more receiving devices **100***b*, . . . , **100***n*. Receiving device **100***n* may perform the functionality of error replication module **136***a* of testing module **130***a*. Both sending device **100***a* and receiving device **100***n* may perform some or all of the functionality of error handling module **134***a* of testing module **130***a*.

Computing Device

According to an aspect of the invention, computing device **40** may comprise a non-transitory electronic storage media **50** configured to store information related to field user testing of one or more test applications, one or more physical processors **42** configured to execute one or more computer modules, and/or other components. The one or more computer modules of computing device **40** may comprise, for example, a network module **44** configured to facilitate communication with network **20** and with plurality of mobile devices **100***a*, **100***b*, . . . , **100***n*, an error analysis module **46** configured to provide analysis related to a test application, a reporting module **48** configured to facilitate analysis and report information related to information stored at non-transitory electronic storage media **50**, and/or other modules.

Computing device **40** may be any computing device such as, for example, a server, a desktop computer, laptop computer, personal digital assistant, smart phone, tablet, and/or any other computing device. Computing device **40** may be capable of communicating with one or more mobile devices **100***a*, **100***b*, . . . , **100***n* over network **20**. Computing device **40** may also include other components typically found in computing devices, including, for example, user input features (e.g., a touch screen, microphone, keyboard, and/or other user input features), speakers, an antenna (and the corresponding signal processing capabilities), and other features. Other computing devices at system **10** may include similar features.

Processor **42** may provide information processing capabilities within computing device **40**. As such, processor **42** may include one or more of a digital processor, an analog processor, a digital circuit designed to process information, an analog circuit designed to process information, a state machine, and/or other mechanisms for electronically processing information. Although processor **42** is shown in FIG. **2** as a single entity, this is not intended to be limiting, as processor **42** may include a plurality of processors operating in coordination or cooperation. This may include implementations in which computing device **40** includes a multi-processor device, a farm of server devices operating together, and/or virtual resources provided by the cloud. Processor **42** may be configured to execute modules **44**, **46**, and/or **48**. Processor **42** may be configured to execute modules **44**, **46**, and/or **48** by software, hardware, firmware, some combination of software, hardware, and/or firmware, and/or other mechanisms for configuring processing capabilities on processor **42**.

It should be appreciated that although modules **44**, **46**, and/or **48** are illustrated in FIG. **2** as being co-located within a single computing device, in implementations in which processor **42** includes multiple processing units, one or more of modules **44**, **46**, and/or **48** may be located remotely from the other modules. The description of the functionality provided by the different modules **44**, **46**, and/or **48** described below is for illustrative purposes, and is not intended to be limiting, as any of modules **44**, **46**, and/or **48** may provide more or less functionality than is described. For example, one or more of modules **44**, **46**, and/or **48** may be eliminated, and some or all of its functionality may be provided by other ones of modules **44**, **46**, and/or **48**. As another example, processor **42** may be configured to execute one or more additional modules that may perform some or all of the functionality attributed below to one of modules **44**, **46**, and/or **48**.

Non-transitory electronic storage media **50** may comprise electronic storage media that electronically stores information non-transiently. The electronic storage media of non-transitory electronic storage media **50** may include one or both of system storage that is provided integrally (i.e., substantially non-removable) with computing device **40** and/or removable storage that is removably connectable to computing device **40** via, for example, a port (e.g., a USB port, a firewire port, etc.) or a drive (e.g., a disk drive, etc.). Non-transitory electronic storage media **50** may include one or more of optically readable storage media (e.g., optical disks, etc.), magnetically readable storage media (e.g., magnetic tape, magnetic hard drive, floppy drive, etc.), electrical charge-based storage media (e.g., EEPROM, RAM, etc.), solid-state storage media (e.g., flash drive, etc.), and/or other electronically readable storage media. Non-transitory electronic storage media **50** may include one or more virtual storage resources (e.g., cloud storage, a virtual private network, and/or other virtual storage resources). Non-transitory electronic storage media **50** may store software algorithms, information determined by processor **42**, information received from computing device **40**, information received from one or more mobile devices **100***a*, **100***b*, . . . , **100***n*, and/or other information that enables computing device **40** to function as described herein.

In some implementations, non-transitory electronic storage media **50** may comprise at least one database that stores system data such as information related to system usage, customer information, distillery content, and/or other data. Non-transitory electronic storage media **50** may be associated and communicate with computing device **40**. For example, one or more databases comprising non-transitory electronic

storage media **50** may be, include, or interface to, for example, an Oracle™ relational database sold commercially by Oracle Corporation. Other databases, such as Informix™, DB2 (Database 2) or other data storage, including file-based, object, or query formats, platforms, or resources such as OLAP (On Line Analytical Processing), SQL (Standard Query Language), NoSQL, a SAN (storage area network), Microsoft Access™ or other form of database may also be used, incorporated, or accessed. The database may comprise one or more such databases that reside in one or more physical devices and in one or more physical locations. The database may store a plurality of types of data and/or files and associated data or file descriptions, administrative information, or any other data.

In some implementations, non-transitory electronic storage media **50** may be part of or hosted by a computing device on network **20**. In some implementations, non-transitory electronic storage media **50** may be part of or hosted by computing device **40**. In some implementations, non-transitory electronic storage **50** may be physically separate from computing device **40** but may be operably communicable therewith.

Non-transitory electronic storage media **50** (of computing device **40**) may be configured to store one or more test applications, information related to one or more mobile devices **100***a*, **100***b*, . . . , **100***n*, information related to one or more operations performed by the test application at one or more mobile devices **100***a*, **100***b*, . . . , **100***n*, error information received from one or more mobile devices **100***a*, **100***b*, . . . , **100***n*, replication information received from one or more mobile devices **100***a*, **100***b*, . . . , **100***n*, data related to analysis of the one or more test applications, and/or other information related to field user testing of the one or more test applications. In one implementation, non-transitory electronic storage media **50** may comprise an error log configured to store information relating to one or more errors that occurred during testing of a test application. In one implementation, non-transitory electronic storage media **50** may store a list of mobile devices **100***a*, **100***b*, . . . , **100***n* to which the test application is deployed. The list may include attributes related to one or more of mobile devices **100***a*, **100***b*, . . . , **100***n*.

For each test application, non-transitory electronic storage media **50** may store information relating to expected results based on execution of operations of the test application. Non-transitory electronic storage media **50** may store information related to one or more events that indicate that an error occurred. The information related to the one or more events may indicate that an error occurred with an operation of the test application, with operation of mobile device **100***n*, and/or that another type of error occurred.

Error analysis module **46** (of computing device **40**) may be configured to receive, from sending device **100***a*, information related to one or more operations performed by the test application at sending device **100***a*. For example, error analysis module **46** may be configured to receive the information from sending device **100***a* at pre-determined intervals, in response to a request for the information transmitted from computing device **40** to sending device **100***a*, and/or in response to other information. In one implementation, error analysis module **46** may be configured to transmit the received information to one or more receiving devices **100***b*, . . . , **100***n*.

Error analysis module **46** may compare received information relating to an operation and information stored at non-transitory electronic storage media **50** relating to the operation. In response to a determination that received information does not match stored information relating to expected results, error analysis module **46** may indicate that an error occurred with the operation.

Error analysis module **46** may compare received information and information stored at non-transitory electronic storage media **50** relating to the one or more events. In response to a determination that received information matches information relating to one or more events, error analysis module **46** may indicate that an error occurred with the operation.

Error analysis module **46** may be configured to also receive error information related to an error that occurred with an operation of the test application.

Error analysis module **46** may store, at an error log of non-transitory electronic storage media **50**, received information relating to an operation at which an error occurred, received error information, and/or other information relating to an error that occurred at sending device **100***a*. Computing device **40** may facilitate access, for an application developer associated with a test application, to information at the error log associated with the test application.

In one implementation, error analysis module **46** may receive replication information from one or more receiving devices **100***b*, . . . , **100***n*. The replication information may comprise information related to results of an attempt to replicate the error by one or more receiving devices **100***b*, . . . , **100***n*. The replication information may include information relating to receiving device **100***n* from which the replication information was received. For example, the replication information may include information relating to attributes of receiving device **100***n* from which the replication information was received, such as, for example, hardware of receiving device **100***n*, operating system, operating system version, and/or other attributes. In one implementation, a list of receiving devices **100***b*, . . . , **100***n* accessible by error analysis module **46** may include information relating to attributes of respective receiving devices **100***b*, . . . , **100***n*. Error analysis module **46** may determine whether receiving device **100***n* was able to replicate the error based on a comparison of the replication information received from receiving device **100***n* and corresponding error information.

In one implementation, error analysis module **46** may compare replication information received from one or more receiving devices **100***b*, . . . , **100***n* to which the error information was transmitted. Based on which receiving devices **100***b*, . . . , **100***n* were able to replicate the error, error analysis module **46** may determine attributes of mobile devices **100***b*, . . . , **100***n* associated with the error. For example, error analysis module **46** may determine that the error may occur at mobile devices **100***b*, . . . , **100***n* that share one or more attributes such as, for example, a specific piece of hardware, a type of operating system, a version of an operating system, and/or other attributes. Error analysis module **46** may store, at the error log, information relating to characteristics relating to the error. In one implementation, error analysis module **46** may augment information stored at the error log relating to the error with information relating to attributes associated with devices **100***b*, . . . , **100***n* that produce the error.

Reporting module **48** may be configured to facilitate analysis and report information related to information stored at non-transitory electronic storage media **50**. For example, reporting module **48** may be configured to provide, for a test application, one or more reports related to errors that occurred during testing of the test application, one or more reports comprising information from the error log of non-transitory electronic storage media **50** of computing device **40**, one or more reports related to error information from sending device **100***a* and replication information from one or more receiving

devices **100***b*, . . . , **100***n*, and/or other information related to field user testing of the test application. In one implementation, reporting module **48** may be configured to prepare and/or display reports including statistics regarding field user testing of one or more test applications. The types of reports prepared by reporting module **48** are not limited to the examples described herein.

In one implementation, reporting module **48** may facilitate a search for information related to field user testing of one or more test applications. For example, reporting module **48** may facilitate a search for errors that occurred at mobile devices **100***b*, . . . , **100***n* with a set of specific attributes. In another example, reporting module **48** may facilitate a search for errors that were replicated in other mobile devices. The types of searches facilitated by reporting module **48** are not limited to the examples described herein.

Reporting module **48** may generate reports relating to field user testing of one or more test applications at pre-determined time intervals, in response to a request by an application developer, in response to a request by a user of a mobile device, upon completion of field user testing for a test application, and/or at other times.

Implementations of the invention may be made in hardware, firmware, software, or any suitable combination thereof. Aspects of the invention may also be implemented as instructions stored on a machine-readable medium, which may be read and executed by one or more processors. A machine-readable medium may include any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computing device). For example, a tangible computer readable storage medium may include read only memory, random access memory, magnetic disk storage media, optical storage media, flash memory devices, and others, and a machine-readable transmission media may include forms of propagated signals, such as carrier waves, infrared signals, digital signals, and others. Further, firmware, software, routines, or instructions may be described herein in terms of specific exemplary aspects and implementations of the invention, and performing certain actions. However, it will be apparent that such descriptions are merely for convenience and that such actions in fact result from computing devices, processors, controllers, or other devices executing the firmware, software, routines, or instructions.

FIG. **4** illustrates a flowchart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices **100***a*, **100***b*, . . . , **100***n*, according to an aspect of the invention. The various processing operations depicted in the flowchart of FIG. **4** are described in greater detail herein. The described operations may be accomplished using some or all of the system components described in detail above and, in some implementations, various operations may be performed in different sequences. In other implementations, additional operations may be performed along with some or all of the operations shown in FIG. **4**, while some operations may be omitted. In yet other implementations, one or more operations may be performed simultaneously. Accordingly, the operations as illustrated (and described in greater detail below) are exemplary in nature and, as such, should not be viewed as limiting.

In an operation **402**, a test application may be stored on one or more mobile devices **100***a*, **100***b*, . . . , **100***n*. For example, the test application may be stored on mobile device **100***a* before mobile device **100***a* is made available to a user to test the application, may be received via computing device **40** (e.g., via a download), may be received via network **20**, may be received via an application store accessible via mobile device **100***a*, may be received via another application accessible via mobile device **100***a*, may be uploaded from an electronic storage media, may be received from one or more devices at a cloud computing environment that hosts computing device **40**, and/or may be obtained in other ways. In an implementation in which test scripts are used during testing of the test application, one or more test scripts associated with the test application may be stored at mobile device **100***a*, accessed from computing device **40** (e.g., via a download), accessed from another device via network **20**, uploaded from another device, obtained in a same or similar manner as the test application, and/or obtained in other ways.

In an operation **404**, test application may perform one or more operations on mobile device **100***a*. For example, an operation may be automatically performed according to a test script associated with the test application. In another example, a user may perform one or more operations by the test application.

In an operation **406**, metric collection module **132***a* may collect metrics related to the operations performed. For example, metric collection module **132***a* may collect and store, at non-transitory electronic storage media **140***a*, metrics from the execution of a test application, and metrics from the operation of mobile device **100***a*. For example, for each operation of the test application performed, metric collection module **132***a* may collect and/or store information related to one or more prior operations performed, a state of the test application, a state of mobile device **100***a*, one or more parameters associated with the operation, one or more inputs to the operation, one or more outputs from the operation, a result of the operation, an associated test script, and/or other information related to the operation.

In an operation **408**, collected metrics may be communicated to computing device **40**. For example, metric collection module **132***a* may transmit information related to execution of the test application and operation of mobile device **100***a* to computing device **40**. The transmitted information may include the collected metrics relating to the operations performed by the test application on mobile device **100***a*.

FIG. **5** illustrates a flowchart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention. The various processing operations depicted in the flowchart of FIG. **5** are described in greater detail herein. The described operations may be accomplished using some or all of the system components described in detail above and, in some implementations, various operations may be performed in different sequences. In other implementations, additional operations may be performed along with some or all of the operations shown in FIG. **5**, while some operations may be omitted. In yet other implementations, one or more operations may be performed simultaneously. Accordingly, the operations as illustrated (and described in greater detail below) are exemplary in nature and, as such, should not be viewed as limiting.

In an operation **502**, an error may be detected during testing of the test application at mobile device **100***a*. For example, error handling module **134***a* may compare information collected by metric collection module **132***a* relating to an operation and information stored at non-transitory electronic storage media **140***a* relating to the operation. In response to a determination that information collected by metric collection module **132***a* does not match information relating to the operation stored at non-transitory electronic storage media **140***a*, error handling module **134***a* may indicate that an error occurred with the operation. In another example, error handling module **134***a* may compare information collected by metric collection module **132***a* relating to the operation and

information stored at non-transitory electronic storage media **140***a* relating to the one or more events. In response to a determination that information collected by metric collection module **132***a* matches information relating to one or more events, error handling module **134***a* may indicate that an error occurred with the operation.

In an operation **504**, error information related to the error may be stored. In one implementation, error handling module **134***a* may augment stored information relating to the operation with an indication that an error occurred with the operation. In one implementation, non-transitory electronic storage media **140***a* may store information related to the error separately from information collected by metric collection module **132***a*. For example, non-transitory electronic storage media **140***a* may store error information related to the error in an error log. The error information may include, for example, one or more of an identification of the test application, an identification of the operation at which the error occurred, one or more parameters associated with the operation at which the error occurred, input data for the operation at which the error occurred, output data for the operation at which the error occurred, one or more results of the operation at which the error occurred, information related to one or more operations that occurred before the operation at which the error occurred, one or more parameters for each of the one or more operations, input data for each of the one or more operations, output data for each of the one or more operations, a state of the test application when the error occurred, an associated test script, and/or other information related to the error.

In an operation **506**, error information may be transmitted to other mobile devices **100***b*, . . . , **100***n*. For example, error handling module **134***a* may transmit error information relating to the error to other mobile devices **100***b*, . . . , **100***n*. Error handling module **134***a* may transmit error information relating to the error to mobile devices **100***b*, . . . , **100***n* included in a list stored in non-transitory electronic storage media **140***a*. In one implementation, error handling module **134***a* may request, from computing device **40**, a list of mobile devices **100***b*, . . . , **100***n* to which to transmit error information. In one implementation, error handling module **134***a* may broadcast the error information over network **20** such that all other devices **100***b*, . . . , **100***n* connected to network **20** may receive the error information. In one implementation, error handling module **134***a* may transmit data to a multicast socket at computing device **40** via which the data may be broadcast to all mobile devices **100***b*, . . . , **100***n* able to connect to the multicast socket.

In an operation **508**, replication information related to the error may be received from one or more other mobile devices **100***b*, . . . , **100***n*. For example, error handling module **134***b* may receive replication information from one or more other mobile devices **100***b*, . . . , **100***n* regarding the error information. In one implementation, computing device **40** may receive replication information from one or more other mobile devices **100***b*, . . . , **100***n*. The replication information may comprise information related to results of an attempt to replicate the error by other mobile devices **100***b*, . . . , **100***n*. The replication information may include information relating to mobile device **100***n* from which the replication information was received. For example, the replication information may include information relating to attributes of mobile device **100***n* from which the replication information was received, such as, for example, hardware of mobile device **100***n*, operating system, operating system version, and/or other attributes.

In an operation **510**, the replication information from the one or more other mobile devices **100***b*, . . . , **100***n* may be compared to the error information related to the error that occurred during testing of the test application at mobile device **100***a*. For example, error handling module **134***a* may determine whether another mobile device **100***n* was able to replicate the error based on a comparison of the replication information received from other mobile device **100***n* and the error information relating to the operation at which the error occurred. In one implementation, error handling module **134***a* may determine characteristics relating to the error. For example, error handling module **134***a* may determine that the error may occur at mobile devices **100***b*, . . . , **100***n* that share one or more attributes such as, for example, a hardware component, an operating system, a version of an operating system, and/or other attributes.

FIG. **6** illustrates a flow chart of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention. The various processing operations depicted in the flowchart of FIG. **6** are described in greater detail herein. The described operations may be accomplished using some or all of the system components described in detail above and, in some implementations, various operations may be performed in different sequences. In other implementations, additional operations may be performed along with some or all of the operations shown in FIG. **6**, while some operations may be omitted. In yet other implementations, one or more operations may be performed simultaneously. Accordingly, the operations as illustrated (and described in greater detail below) are exemplary in nature and, as such, should not be viewed as limiting.

In an operation **602**, error information relating to an error that occurred during testing of a test application at another mobile device **100***a* may be received. For example, error replication module **136***a* may receive error information from another mobile device **100***n*. The error information may comprise, for example, an identifier relating to a test application, an operation during which the error occurred, information relating to one or more operations to be executed to reproduce the error, state information relating to the test application when the error occurred, state information relating to mobile device **100***n* when the error occurred, data inputs to the operation and to any operations that preceded the operation at which the error occurred, a test script comprising the operations executed (and corresponding data inputs) to reproduce the error, and/or other information related to the error and/or its reproduction.

In an operation **604**, mobile device **100***n* may perform a replication attempt based on the received error information. In one implementation, error replication module **136***n* may attempt to automatically replicate the error by executing the relevant operations set forth in the test script. In one implementation, the error information may comprise a link to the test application. In response to receipt of user input that accesses the link to the test application, error replication module **136***n* may open the test application. Error replication module **136***n* may automatically execute the operations of the test application using data inputs received in the error information to attempt to reproduce the error. In one implementation, error replication module **136***n* may open the test application and may display instructions regarding how to replicate the error. Error replication module **136***n* may receive user input to execute the operations to reproduce the error.

In an operation **606**, replication information related to the attempt to replicate the error may be stored. For example, metric collection module **132***n* of mobile device **100***n* may collect replication information relating to the attempt to replicate the error. The replication information may comprise

information related to results of an attempt to replicate the error by mobile device **100***n*. The replication information may include information relating to mobile device **100***n*. For example, the replication information may include information relating to attributes of mobile device **100***n*, such as, for example, hardware of mobile device **100***n*, operating system, operating system version, and/or other attributes.

In an operation **608**, replication information may be transmitted to mobile device **100***a* from which the error information was received. For example, error replication module **136***n* may communicate the information collected by metric collection module **132***n* for the operation to mobile device **100***a* from which it received the error information.

FIG. **7** illustrates a data flow diagram of an exemplary method of coordinating field user testing results for a mobile application across various mobile devices, according to an aspect of the invention. The various processing operations depicted in the data flow diagram of FIG. **7** are described in greater detail herein. The described operations may be accomplished using some or all of the system components described in detail above and, in some implementations, various operations may be performed in different sequences. In other implementations, additional operations may be performed along with some or all of the operations shown in FIG. **7**, while some operations may be omitted. In yet other implementations, one or more operations may be performed simultaneously. Accordingly, the operations as illustrated (and described in greater detail below) are exemplary in nature and, as such, should not be viewed as limiting.

Many of the operations set forth in FIG. **7** are similar to those discussed above in relation to FIGS. **4**, **5** and **6**. For example, operations **702**, **704**, **708**, **710**, **714** are similar to operations **404**, **506**,**604**, **608**, **510** respectively, and therefore will not be described again.

In one implementation, in operation **702**, mobile device **100***a* may perform operations by the test application.

Responsive to a determination that an error occurred with an operation of the test application, mobile device **100***a* may transmit error information related to the error to another mobile device **100***b* in an operation **704**.

In an operation **706**, mobile device **100***a* may transmit the error information related to the error to computing device **40**. For example, error handling module **134***a* may transmit error information related to the error to computing device **40** in response to a determination that the error occurred, at predetermined intervals during execution of the test application, and/or in response to other information.

In an operation **708**, mobile device **100***n* may attempt to replicate the error based on the error information received from mobile device **100***a*.

In an operation **710**, mobile device **100***n* may transmit, to mobile device **100***a*, replication information related to the attempt to replicate the error.

In an operation **712**, mobile device **100***n* may transmit, to computing device **40**, replication information related to the attempt to replicate the error. For example, error replication module **136***n* of mobile device **100***n* may communicate the information collected by metric collection module **132***n* during an attempt to replicate the error to computing device **40**.

In an operation **714**, mobile device **100***a* may compare the replication information received from mobile device **100***n* to determine whether mobile device **100***n* was able to replicate the error.

In an operation **716**, computing device **40** may compare the replication information received from mobile device **100***n* with the error information received from mobile device **100***a* to determine whether mobile device **100***n* was able to replicate the error. For example, error analysis module **46** of computing device **40** may compare replication information received from one or more receiving devices **100***b*, . . . , **100***n* to which the error information was transmitted. Based on which receiving devices **100***b*, . . . , **100***n* were able to replicate the error, error analysis module **46** may determine attributes of mobile devices **100***b*, . . . , **100***n* associated with the error. For example, error analysis module **46** may determine that the error may occur at mobile devices **100***b*, . . . , **100***n* that share one or more attributes such as, for example, a specific piece of hardware, a type of operating system, a version of an operating system, and/or other attributes. Error analysis module **46** may store, at the error log, information relating to characteristics relating to the error. In one implementation, error analysis module **46** may augment information stored at the error log relating to the error with information relating to attributes associated with devices **100***b*, . . . , **100***n* that produce the error.

Aspects and implementations described herein as including a particular feature, structure, or characteristic, but every aspect or implementation may not necessarily include the particular feature, structure, or characteristic. Further, when a particular feature, structure, or characteristic is described in connection with an aspect or implementation, it will be understood that such feature, structure, or characteristic may be included in connection with other aspects or implementations, whether or not explicitly described. Thus, various changes and modifications may be made to the provided description without departing from the scope or spirit of the invention. As such, the specification and drawings should be regarded as exemplary only, and the scope of the invention to be determined solely by the appended claims.

What is claimed is:

1. A system for performing field testing of a test application, the system comprising:

a computer system comprising one or more physical processors programmed with computer program instructions which, when executed by the one or more physical processors, cause the computer system to:

obtain one or more metrics related to execution, at a mobile device, of one or more operations of the test application;

determine, based on the one or more metrics, whether an error occurred with an operation of the one or more operations;

cause error information relating to the error to be transmitted to one or more other mobile devices responsive to a determination that the error occurred with the operation, wherein the error information includes information for replicating the error;

receive, back from at least a first other mobile device of the one or more other mobile devices, replication information relating to an attempt by the first other mobile device to replicate the error; and

determine whether the first other mobile device replicated the error based on the replication information.

2. The system of claim **1**, further comprising:

non-transitory electronic storage media configured to store one or more test scripts relating to the test application, an individual test script comprising the one or more operations to be performed in a set order.

3. The system of claim **2**, wherein the computer system is further caused to:

determine that the error occurred with the operation based on a comparison of the one or more metrics and expected results associated with the operation.

4. The system of claim 1, further comprising:

non-transitory electronic storage media configured to store one or more events, an individual event comprising information indicating that an error occurred with one or more of the mobile device or the test application.

5. The system of claim 4, the computer system is further caused to:

determine that the error occurred with the operation based on a comparison of the one or more metrics and the stored one or more events.

6. The system of claim 1, wherein the computer system is further caused to:

transmit, at one or more pre-determined intervals, the one or more metrics to a computing device remote from the mobile device and the one or more other mobile devices.

7. The system of claim 1, wherein the computer system is further caused to:

transmit the error information to the computing device.

8. The system of claim 1, wherein the computer system is further caused to:

obtain at least a first attribute of the first other mobile device responsive to a determination that the first other mobile device replicated the error;

determine that the mobile device shares the first attribute in common with the first other mobile device; and

identify the first attribute as being a possible cause of the error.

9. The system of claim 8, wherein the first attribute comprises at least one of a hardware component, an operating system, or an operating system version.

10. The system of claim 1, wherein the error information includes a link to a test script, wherein the test script is used to automatically attempt to replicate the error.

11. The system of claim 1, wherein the error information includes one or more instructions that causes the first other mobile device to prompt an end user to perform the operation at the first other mobile device to attempt to replicate the error.

12. The system of claim 1, wherein the computer system is further caused to:

receive, from at least a second other mobile device, second error information relating to a second error at the second other mobile device;

determine at least a second operation to execute to attempt to replicate the second error;

cause the second operation to be executed at the mobile device;

obtain one or more second metrics related to the execution of the second operation; and

determine whether the second error was replicated based on the one or more second metrics.

13. The system of claim 12, wherein the computer system is further caused to:

cause second replication information that indicates that the second error was replicated to be transmitted to a device remote from the mobile device responsive to a determination that the second error was replicated.

14. The system of claim 13, wherein the device remote from the mobile device comprises at least one of the one or more other mobile devices or a computing device remote from the mobile device and the one or more other mobile devices.

15. The system of claim 1, wherein the computer system is further caused to:

identify the one or more other mobile devices to which to transmit the error information based on a list of one or more mobile devices stored at the non-transitory electronic storage media.

16. The system of claim 1, wherein the computer system is further caused to:

cause a request for a list of one or more mobile devices to which the error information should be provided to be transmitted to a computing device remote from the mobile device and the one or more other mobile devices;

obtain the list of one or more mobile devices based on the request; and

identify the one or more other mobile devices to which to transmit the error information based on the list of one or more other mobile devices.

17. The system of claim 1, wherein to cause the error information relating to the error to be transmitted to the one or more other mobile devices, the computer system is further caused to:

cause the error information to be transmitted to a multicast socket of a computing device remote from the mobile device and the one or more other mobile devices.

18. The system of claim 1, wherein the computer system comprises the mobile device, the mobile device comprises the one or more physical processors, and the computer program instructions are part of an operating system of the mobile device.

19. A method of performing field testing of a test application, the method being implemented by a computer system comprising one or more physical processors executing computer program instructions which, when executed by the one or more physical processors, perform the method, the method comprising:

obtaining, by the computer system, one or more metrics related to execution, at a mobile device, of one or more operations of the test application;

determining, by the computer system, based on the one or more metrics, whether an error occurred with an operation of the one or more operations;

causing, by the computer system, error information relating to the error to be transmitted to one or more other mobile devices responsive to a determination that the error occurred with the operation, wherein the error information includes information for replicating the error;

receiving, by the computer system, back from at least a first other mobile device of the one or more other mobile devices, replication information relating to an attempt by the first other mobile device to replicate the error; and

determining, by the computer system, whether the first other mobile device replicated the error based on the replication information.

20. The method of claim 19, further comprising:

storing, by the computer system, at non-transitory electronic storage media of the computer system, one or more test scripts relating to the test application, an individual test script comprising one or more operations to be performed in a set order.

21. The method of claim 20, further comprising:

determining, by the computer system, that the error occurred with the operation based on a comparison of the one or more metrics and expected results associated with the operation.

22. The method of claim 19, further comprising:

storing, by the computer system, at non-transitory electronic storage media of the computer system, one or more events, an individual event comprising information indicating that an error occurred with one or more of the mobile device or the test application.

23. The method of claim 22, further comprising:

determining, by the computer system, that the error occurred with the operation based on a comparison of the one or more metrics and the stored one or more events.

24. The method of claim 19, further comprising:

transmitting, by the computer system, at one or more predetermined intervals, the one or more metrics to a computing device remote from the mobile device and the one or more other mobile devices.

25. The method of claim 19, further comprising:

transmitting, by the computer system, the error information to the computing device.

26. The method of claim 19, further comprising:

obtaining, by the computer system, at least a first attribute of the first other mobile device responsive to a determination that the first other mobile device replicated the error;

determining, by the computer system, that the mobile device shares the first attribute in common with the first other mobile device; and

identifying, by the computer system, the first attribute as being a possible cause of the error.

27. The method of claim 26, wherein the first attribute comprises at least one of a hardware component, an operating system, or an operating system version.

28. The method of claim 19, further comprising:

receiving, by the computer system, from at least a second other mobile device, second error information relating to a second error at the second other mobile device;

determining, by the computer system, at least a second operation to execute to attempt to replicate the second error;

causing, by the computer system, the second operation to be executed at the mobile device;

obtaining, by the computer system, one or more second metrics related to the execution of the second operation; and

determining, by the computer system, whether the second error was replicated based on the one or more second metrics.

29. The method of claim 19, wherein the computer system comprises the mobile device, the mobile device comprises the one or more physical processors, and the computer program instructions are part of an operating system of the mobile device.

30. A non-transitory electronic storage media storing computer program instructions for performing field testing of a test application, the computer program instructions, when executed by a computer system, causes computer system to:

obtain one or more metrics related to execution, at a mobile device, of one or more operations of the test application;

determine, based on the one or more metrics, whether an error occurred with an operation of the one or more operations;

cause error information relating to the error to be transmitted to one or more other mobile devices responsive to a determination that the error occurred with the operation, wherein the error information includes information for replicating the error;

receive, back from at least a first other mobile device of the one or more other mobile devices, replication information relating to an attempt by the first other mobile device to replicate the error; and

determine whether the first other mobile device replicated the error based on the replication information.

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